Diablo model 1200 HyType 1 printer interface

Release version 2.0

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Every effort has been made to supply complete and accurate information. However, Bes assumes no responsibility for any errors in this manual, in the interface's hardware or software, nor for any resulting damages.

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1. Introduction

The Bes printer interface for the Diablo model 1200 HyType I printer allows you to take full advantage of all possibilities of this kind of daisy wheel systems. Equipped with a parallel interface and a buffer of 20000 characters effectively, it allows your computer to continue program execution while text is being printed. Three different kinds of print modes are supported, allowing the printer to be used as a high performance typewriter, an intelligent printer, or as a plotter. Almost all print parameters can be set under software control, using only printable characters. Efforts have been made to maintain compatibility with existing printers in order to allow its use in combination with software written for standard printers/plotters.

As mentioned above, two print modes, and one plot mode are supported. The two print modes are totaly different. Mode select is done by means of a switch. The interface allows switching between the selected print mode and the plot mode under software control.

2. Hardware specifications

2.1 Diablo model 1200 HyType 1 printer specifications

Horizontal specifications:

Print line length	132 inch = 33.5 cm 792 column positions 130 characters at 10 char/inch 156 characters at 12 char/inch 195 characters at 15 char/inch
step size	1/60 inch/step = 0.43 mm/step 60 steps/inch = 23.6 steps/cm
Traveling speed	400 ms for full length travel

Vertical specifications:

Transport	Both forward as reverse feed
step size	1/48 inch/step = 0.53 mm/step 48 steps/inch = 18.9 steps/cm
Transport speed	4 inches/sec = 10.16 cm/sec + 45 ms settling time.

2.2. Interface specification

Host interface:	Centronics compatible parallel input.
Internal memory:	Host input character buffer of 14000 characters. Character compression allows buffering of 20000 characters typically

3. Print modes

3.1. Print mode 0

Mode 0 simulates a high performance typewriter. Text processing is done on acharacter basis; characters are processed at the moment they are received.

Mode 0 control characters

The following control characters are supported:

Key	Code	Function
SOH=Ctrl A	1/01H	Flush host input buffer
=Ctrl B	2/02H	Clear all tabs
BEL= Ctrl G	7/07H	Bell signal
BS = Ctrl H	8/08H	Backspace
TAB= Ctrl I	9/09H	Tab
LINE FEED Ctrl J	10/0AH	ALF on: New line, ALF off: line feed
VT = Ctrl K	11/0BH	New line
FF = Ctrl L	12/0CH	New line
CAR RET-Ctrl M	13/0DH	ALF on: New line, ALF off: carriage return
=Ctrl N	14/0EH	Reset underlining
= Ctrl O	15/0FH	Set underlining
17/11 H=Ctrl R	17/11H	Set plot mode
=Ctrl S	18/12H	Set tab
19/13H=Ctrl T	19/13H	Reset tab
SUB =Ctrl Z	26/1AH	Start command line (see section 4.2.)
ESC=Escape	27/1BH	Start escape sequence (see section 4.1.)

CtrL = SUB key = 1A H

3.2. Print mode 1

When the printer is operating in mode 1, characters are processed on a line basis; A line of characters is printed as soon as a line terminator is encountered, or the maximum line length is exceeded. When enabled, the printer will print bidirectional. Another feature which speeds up printing is the fact that a string of spaces is skipped at once instead of in severel steps. See section 7. for printing speed evaluation.

Control characters

Key	Code	Function
SOH = Ctrl A	1/01H	Flush host input buffer
STX = Ctrl B	2/02H	Clear tabs
BEL = Ctrl G	7/07H	Bell signal
TAB = Ctrl I	9/09H	Tab
LINE FEED = Ctrl J	10/0AH	ALF on: New line, ALF off: line feed
VT = Ctrl K	11/0BH	Unconditional new page.
FF = Ctrl L	12/0CH	Conditional new page.
CAR RET = Ctrl M	13/0DH	ALF on: New line, ALF off: carriage return
= Ctrl N	14/0EH	Reset underline
= Ctrl O	15/0FH	Set underline
= Ctrl R	18/12H	Set plot mode
19/13H = Ctrl S	19/13H	Set tab
= Ctrl T	20/14H	Reset tab
SUB = Ctrl Z	26/1AH	Start command line (see section 4.2.)
ESC = Escape	27/1BH	Start escape sequence (see section 4.1.)

CtrL = SUB Key = 1A H

4. Special commands

4.1. Escape sequence

The following two-character escape sequences are defined:

Escape - 30/1EH : Set superscript mode/Reset subscript mode. ESC – RS
Escape - 28/1CH : Set subscript mode/Reset superscript mode. ESC – FS

4.2. Command line handling

Command lines allow the user to set several options under software control in a convenient way. Command lines are in full ASCII. Normally, a command line is initiated with a Ctrl Z character. In mode 1, however, you can also initiate a command line with the three-character sequence '(*)'. Any leading characters on the current line are ignored. This feature, which can be disabled, allows you to send command lines from program that are not capable of sending control codes.

The following options are supported:

B=Y/N	Bidirectional printing control. B=N disables bidirectional printing. Default is B=Y. (Mode 1 only)
C=XXX	Set characters/line. Valid range is 1-780. When exceeding this number of characters, the rest of the line is printed on the next line. Note that the actual allowed number of characters on a line can never exceed what is physical possible for the printer (See the W option for the maximum C value when using standard character densities). The default is C=138.
D=Y/N	Double strike control. D=Y causes every character to be printed twice, resulting in darker printing. This slows down printing significantly. Default is D=N.
E=Y/N	Command sequence recognition flag. E=Y enables the character sequence '(*)' to be recognized as initiating a command sequence. Default is E=Y. (Mode 1 only)
G=Y/N	Special high quality positioning flag. When this flag is set, every time the carriage is to be positioned, it is first positioned to one step before the actual position. This causes carriage positioning errors to be contant and therefore almost invisible. You are advised to use this option when using a W option value less than 5. Bidirectional printing should not be used when this option is used. Default is G=N.
H=XXX	Set lines between pages. Valid range is 0-20. Default is H=6. (Mode 1 only)
I=XXX	Set left margin distance (in characters). Valid range is 0-780. Default is I=0.
L=XXX	Set lines/page. Valid range is 0-200. L=0 disables paging. Specifying this parameter causes the linecounter to be reset. Default is L=0. (Mode 1 only)
N	New page command. Only one new page is taken regardless the number of N-options used. (Mode 1 only)

P=N/XXX	Set page-numbering. P=N disables page numbering. P=XXX sets pagenumbering with first page number XXX. The pagenumber is printed at the upper right top of the page. Pagenumbering is only enabled when the following conditions are met: - At least 3 lines/page - At least 10 characters/line If, after interpreting the rest of the command, the printer is at the top of a page, the pagenumber in printed immediately. You can force the printer to do this by including a 'L=XXX' command, which resets the linecounter. Valid range is 0-65534. Default is P=N. (Mode 1 only)
Q=XXX	Set steps/line. Valid range is 1-255. The default value depends on the letterwheel size switch HOP: switch up sets Q=7, down to Q=8.
R	Reset all options to their default values. This command overrules all leading commands. The R option has the same effect as specifying: B=Y,C=138,D=N,E=Y,G=N,H=6,I=0,L=0,P=N,T='',X=N,Z=Y The default values for W and Q depends on the letterwheel size switch HOP: switch up: W=5,Q=7, down: W=6,Q=8.
T=TITLE	The title-string between the single quotes is printed at the top of every page. If pagenumbering is specified, the pagenumber appears on the same line. The title line is followed by an empty line. T='' diables titeling. Titling is only enabled when the following conditions are met: - At least 3 lines/page - At least 10 characters/line If, after interpreting the rest of the command, the printer is at the top of a page, the titleline is printed immediately. You can force this by including a 'L=XXX' command, which resets the linecounter. Valid stringlength range: 0-100 characters. Default is T=''. Superscript, subscript and underlining are allowed in the titlestring. (Mode 1 only)
V	This command produces a copyright notice, and the version number of the resident interface program.
W=XXX	Set steps/character. Valid range is 1-255. The default value depends on the letterwheel size switch HOP: switch up sets W=5, down to W=6. Use the following setting for the most common character densities: 10 Char/inch : W=6 (Option C <= 130) 12 Char/inch : W=5 (Option C <= 156) 15 Char/inch : W=4 (Option C <= 195, G=Y is recommended)
X=Y/N	Set individual sheet flag. When paper is feed to a new page and the option X=Y is specified, the printer produces an audible signal, and waits for CAR RET to be pressed on its keyboard before it continues printing. This in order to allow the operator to insert a new sheet. Default is X=N. (Mode 1 only)
Z=Y/N	Set zero-slashing. Z=Y causes the character '0' to be printed as the character '0' overprinted with the character '/'. Default is Z=Y.
*	Optional command line terminator. All trailing characters on the line are skipped.

Both upper and lowercase characters are accepted. Spaces are ignored, except in the T command titlestring. Options not active under the specified mode are not assumed to be in error when specified. Switching modes does not alter any options set, causing only those options not valid under the new mode to be disabled temporary. When parameters are considered to be conflicting seriously, the message 'CONFLICTING PARAMETERS' is printed, and the system is reset to it's default parameters. This check is made after the whole command line is interpreted. Serious conflicts exist for instance when the number of steps/character multiplied by the number of characters/line ((C+I)*W)) exceeds 780, as this would imply exceeding the printer's carriage width.

5. Plot mode

5.1 Introduction

When in the plot mode, the Diablo printer behaves as a drum type plotter. This means that the horizontal number of steps is limited to the width of the "drum" (carriage), and the vertical number of steps only by the length of your paper. Unfortunately, the horizonal and vertical step size are not equal. You should consider this when writing plot programs. Plotting is performed using the period character as a dot.

When operation in the plot mode, all input is treated as full ASCII commands. A command consist of a alphabetic character (both upper and lower case accepted), followed when needed by parameters. Parameters are separated by commas. Spaces are ignored. In most cases, the parameters are numeric values. Although all internal processing is done with integer arithmetic, a limited form of floating point input format are allowed. This is in order to facilitate software program interfacing. The following rules apply:

- Numeric values must be in the range -9999 to +9999.

- Values may or may not be proceded by a sign (+ or -).

- Values may or may not have a fractional part. When present, it is used to round the value to the nearest integer value.

For example, the following numeric parameters are legal:

2	+2	+2.1	representing the value 2.
0.1	+0.1	+.1	representing the value 0.
-1	-1.4	-0.5	representing the value -1.

Command lines can be as long as 780 characters. Packing more than one command on one command line is allowed, but not recommended.

5.2. Command description

5.2.1. Line plot commands

Plot Absolute : D<xcoor>,<ycoor>(,<xcoor>,<ycoor>)

Draw a line from the current position to the specified position. When more coordinates are specified, drawing is continued from the previous coordiate to the next coordinate. Example:

D10,0,10,10,0,10,0,0 draws a box:

Plot Relative : J<xcoor>,<ycoor>(,<xcoor>,<ycoor>)

Draw a line from the current position to the specified position relative to the current position. When mode coordinates are specified, drawing is continues from the previous coordinate to the next coordinate relative to that previous coordinate (!). Example:

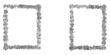
J10,0,0,10,-10,0,0,-10 draws the same box as above:

Move Absolute : M<xcoor>,<ycoor>(,<xcoor>,<ycoor>)

Move the plotter to the new specified coordinate without plotting. When more than one coordinate is specified, the plotter will continue to move to that coordinate. Example:

Drawing two separate boxes can be done with the following commands:

```
D10,0,10,10,0,10,0,0
M20,0
D30,0,30,10,20,10,20,0
```

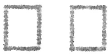


Move Relative : R<xcoor>,<ycoor>(,<xcoor>,<ycoor>)

Move the plotter to the new specified relative coordinate without plotting. When more than one coordiate is specified, the plotter will continue to move to that new relative coordinate. Example:

Drawing the two separate boxes of the example above can also be done with:

```
D10,0,10,10,0,10,0,0
R20,0
D30,0,30,10,20,10,20,0
```



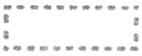
5.2.2. Line plot type command

Set linetype : L(<linetype>)

The current line type is set to the specified type. Type 0 is a solid line. Types 1 to 15 are dashed lines. The greater the value, the farther apart the dashes are. When linetype is not specified, type 0 is assumed. Example:

A box drawn with linetype 2:

```
L2
D40,0,40,10,0,10,0,0
```



5.2.3. Origin related commands

Set Origin : I

Set origin to current coordinate.

Return to Origin : H

Return to current origin.

5.2.4. Character related commands

Print Character : P<printable character>(<printable character>)

All printable characters following this command are plotted using a 7 by 5 matrix. Example:

Use the following command to plot the word "HyType":

PHyType

Set Charactersize : S(<size>)

Set size used for plotting characters. Size 0 are the smallest plottable characters (7 by 5 matrix). Higher sizes (1 to 79) produce characters which are a factor (size-1) greater. Examples:

Size 0: Size 1: Size 2:

Set Printdirection : Q(<direction>)

Set character plot direction. You can plot characters in four directions using values 0 to 3. When direction is not specified, the value 0 is assumed. Examples

Q0 Q1 Q2 Q3

5.2.5. Axis plot command

Plot Axis : X<axis>,<step>,<intervals>

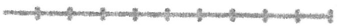
This command allows you to plot a horizontal or vertical axis complete with markers with one command. You must specify the following parameters:

Axis :	1 for horizontal, 0 for vertical axis.
Step :	Distance between two markers in dots. (use negative values to plot the axis to the opposite direction).
Intervals :	Number of markers used. Thus the complete axis is (steps x intervals) dots long.

Example:

X1,10,10

produces the following axis:



5.2.6. Other commands

A

Exit plot mode. The carriage is returned to the most left position, and the operation is resumed in the print mode which was active at the moment the plot mode was entered. You can also exit the plot mode using the control character 17/11H.

6. Operator controls

6.1. Switches

Because most options are software programmable, not all switches provided on the Diablo keyboard are functional. Those who are, are described below:

Lin/Loc	Line-mode restricts input to host only, local to keyboard only. Therefore this switch can be used to stop printing of host output temporarily. No data from the host is lost during local mode.
Reset	Pressing this switch causes the whole system to be reset to the same state as during powering-up. Use this switch only after fatal errors, and to flush the hostbuffer.
HQP	The default lettersize depends on the position of this switch. Up for 12 char/inch, down for 10 char/inch. This switch is only sensed during power-up and reset, and has no effect afterwards.
ALF	Auto linefeed switch. When up, both the codes 0AH and 0DH result in a NLCR. When down, 0DH only moves the carriage back to the begin of the line, and 0AH only produces a line feed.
VTO	Display feed option switch. When up, the Diablo automatically feeds the paper up 16 steps when no characters are entered in the last 3 seconds. This allows the operator to see what is printed last.
S1	Mode switch. Up sets the system in mode 0, the typewriter mode. Down to mode 1, the intelligent printer mode.

6.2 Indication LEDs

All four indication LEDs are supported:

Power	On whenever the system is operating
KBE	Keyboard enable LED. Keyboard entries are possible whenever this LED is on
CD	Is on whenever the host buffer contains character to print.
RD	Is on when the host input buffer is full.

7. Print speed report

In contrast with matrix type printers, the printing speed of daisy wheel printers heavily depends on the kind of text to print. The process that usually takes the most time is the positioning of the right character petal of the printwheel. The arrangement of the petals is based on average character occurence in typical texts. The "typical" text however is a fiction. Therefore, a print speed report cannot be accurate. It can merely give an indication of the printer's performance. This report contain three benchmark texts, ranging from a "worst case" text to a text giving very flattering results. The average performance will be in between.

The tests are executed in mode 1; when you are not using keyboard input, there is absolutely no reason to use mode 0. When you do use keyboard input, printing speed will always be substantially higher than the fastes typist.

The test were performed with the options set as following:
G=N,Z=N,W=6,Q=8

7.1 Worst case text

The text consist of 50 lines of 80 random characters, chosen with equal probability out of the complete set of 96 characters.

Unidirectional printing : 18.2 char/sec.
Bidirectional printing : 18.7 char/sec.

Of course you can produce even worse results when printing lines of two characters which are at the opposite position of the printwheel. It is however very unlikely that the printspeed will ever drop below the 18 char/sec.

7.2 Average text

This test is essentially the same as the previous test, except that the characters were chosen out of the uppercase characterset including the space, and that the character probability was proportionally to their frequency of appearence in "average" american text. (Sergio Mello-grand, Byte februari 1984, page 193) The results:

Unidirectional printing : 30.8 char/sec.
Bidirectional printing : 32.5 char/sec.

7.3 Table test

The test was the printing of 50 lines of 10 columns, each column consisting of 5 spaces and 3 randomly chosen digits. The results of this test are very flattering because of the fact that the printer takes full advantage of its capability to skip strings of spaces at once.

Unidirectional printing : 55.6 char/sec.
Bidirectional printing : 62.5 char/sec.

7.4 Plot mode

Plotting speed is determined by the time the printer can take a horizontal and vertical step. For pure horizontal and vertical lines, the following characteristics apply:

Horizontal stepping rate : 30 dots/sec.
Vertical stepping rate : 10 dots/sec.

In most cases, the dot rate will not be much over 10 dots/sec for diagonally lines.

```
! " # $ % & ' (
) * + , - . / 0 1 2
3 4 5 6 7 8 9 : ; <
= > ? @ A B C D E F
G H I J K L M N O P
Q R S T U V W X Y Z
↑ ↓ ← → ⊠ ` a b c d
e f g h i j k l m n
o p q r s t u v w x
y z [ ¦ ] ~
```